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ON THE ANATOMY OF THE "NONFACILITATING" FEATURES OF THE DOUBLE AUCTION INSTITUTION IN CONSPIRATORIAL MARKETS

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ABSTRACT

Effective conspiracies are more easily formed in posted-offer and in sealed bid markets than in double auction markets. A feature of double auctions is isolated as the possible source of the behavioral differences. The double auction presents conspirators with continuous temptations to defect. It also fosters additional competition among sellers for access to buyers caused by the New York rule that requires that only the (first) best offers are exposed to the market and can be replaced only by better offers. This second competition can be interpreted as a coordination problem for volume allocation which could interact with other features of the process to undermine conspiracy. The research demonstrates that the continuous temptation to defect feature has its own independent influence which can account for observed differences.

On The Anatomy of the "Nonfacilitating" Features of the Double Auction Institution in Conspiratorial Markets[1]

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This study focuses on a question that emerges naturally from literature on the relationship between the details of market institutions and market performance. The existing experimental literature has demonstrated that the successful operation of a market conspiracy is profoundly influenced by the structure of the markets in which they operate. Conspiracies operating within the framework of the double auction do not tend to be successful in influencing prices and quantities to their advantage. However, conspiracies operating within a sealed bid environment or within a posted price environment are successful.

The "success" of a conspiracy can be analyzed at five different levels (Isaac and Plott, 1981). Do potential agents recognize their common self interest and explore and discuss conspiracies? Does a conspiracy actually evolve in the sense that agents manage to reach an agreement? Is the agreement implemented? Does the implemented agreement actually influence the market? Are the effects to the advantage of the conspirators? The analysis in this paper is primarily concerned with these various possibilities and their relationship to the details of market organization.

Previous studies have provided the following results upon which the study is built. First, it appears that in all markets studied to date, the opportunity to conspire is quickly followed by attempts to conspire. The data show that an immediate recognition of the potential benefits of conspiracy are not beyond the cognitive, perceptual, and moral capacities of humans in general. Somewhat surprising is the fact that the potential for conspiracy translates itself into an actual conspiracy in the sense that a common strategy can be quickly recognized, articulated and agreed upon. Implementation is usually attempted but successful implementation and the success of implementation once the implementation is complete are different matters. The success of conspiracy implementation is dependent upon the details of the market organization.

[1]The research support of the National Science Foundation and the Caltech Laboratory of Experiments in Economics and Political Science is gratefully acknowledged.

Studies have tended to focus on agents that do not have a long term relationship or substantial experience in the sense of dozens or more conspiracies. Similarly, studies have not focused on circumstances in which the conspiracy might be enforced by institutions and incentives external to the market. A strong presumption exists that relationships involving time and additional institutional linkages can serve to facilitate successful collusion. Because of this presumption, studies have focused on settings in which neither time nor substantial institutional machinery operate to facilitate conspiracy. Instead, the focus has been on the influence of facilitating devices under circumstances in which the presumption suggests that successful conspiracies will *not* otherwise exist. The questions posed address the features of institutions and organizations that make successful conspiracy easy and why.

1 The Experimental Literature

Conspiracies were first studied in a laboratory experimental setting by Isaac and Plott (1981). The markets were (parametrically) stationary with each period (day) of market activity involving the same underlying demand and supply configurations. The markets were organized as double oral auctions with "offer improvement rules." Offer improvement rules (the "New York" rule) means that for a bid (ask) to seize the floor it must be higher (lower) than the standing bid (ask). In other words, only the "best" offers are exposed to the floor. This improvement rule is important, as will become clear later.

Between periods (days) the buyers and sellers were in different rooms. Under the conspiracy treatment conditions, one side (e.g. sellers) were allowed to formulate a joint strategy for the upcoming period. The explicit language was:

> **Except for the bids and their acceptance and except during periods of recess, you are not to speak to any other subject.** During periods of recess you are free to discuss whatever you wish as long as you stay within the confines of the rules: you cannot discuss side payments or make physical threats and you can't reveal the detailed quantitative information on your payoff charts. Other than those specific things you can discuss all aspects of the market fully.

The results of Isaac and Plott are striking. Conspiracies readily form. Some effects of the conspiracy can be detected in the market. However, the most important possible effect of conspiracies, the phenomenon that is anticipated by theories, laws, and regulations, was not observed. The conspiracy did little to help the conspirators. Conspiracies quickly unraveled and prices converged to prices near competitive levels.

The study of conspiracies was carried a step further by Isaac, Ramey, and Williams (1984) who studied posted offer markets, and by Isaac and Walker (1985) who studied sealed bid markets. Posted offer involves each seller privately choosing a price and quantity. Once chosen neither can be changed. All offers are exposed to the buyers at the same time. In random order, buyers are allowed to purchase from the seller of their choice. In the absence of conspiracy, posted offer processes are known to result in prices that are somewhat higher than the competitive equilibrium and have a tendency to converge to near the competitive equilibrium from above. Under conditions of conspiracy, the posted offer process does not show such a tendency toward the competitive equilibrium. By contrast, under conspiracy, prices frequently approach the levels predicted by cartel theory and the sellers are advantaged by conspiracy.

Sealed bid processes are similar to posted price processes. Bids are tendered in private and cannot be changed once tendered. However, unlike posted price processes, sealed bids involve the sale of only one unit of a product to the highest bidder. Conspiracy works to the advantage of the conspirators under the sealed bid processes.

2 A Comparison of Institutions

The stylized facts are easily stated. People who are not particularly experienced in participating in markets and in conspiracies find themselves involved in a successful conspiracy when participating in one type of market. However, these same people (same subject pool) find themselves attempting to conspire but failing to be effective when participating in a market that is organized differently. Presumably, some feature of the market is instrumental in bringing about the difference in performance. The natural question to pose is "What is it that makes such a profound difference?".

Incentive theory and game theory suggests a line of investigation. Notice that the double auction presents a **continuous temptation** to cheat on any previous agreement. Such continuous temptation does not exist under posted prices. The double auction also presents a special coordination problem to conspirators that the posted price process does not. The coordination problem is related to the fact that the improvement rule typically employed in double auctions creates a difficult problem of access to the buyers for conspirators. With limited access to buyers, a seller gets a limited market share. Somehow the conspiracy must solve a coordination problem to determine the amount sold by each seller at any agreed–upon price. Under posted prices the allocation of buyers to sellers tends to be determined without any special institution agreement.

The nature of a conspiracy makes clear both the nature of the temptation and the nature of the coordination problem. The temptation to defect is continuous. Under the double auction process (but not under posted offer or sealed bid), bids and asks are tendered in real time. Since any agent is free to accept the bid/ask of any other agent at

any time, any party to a conspiracy has an opportunity to defect at any time. As is the case with any prisoner's dilemma, defection can generate (possibly temporary) personal gains. The opportunity to defect presents itself every moment.

The roots of the coordination are also clear. An effective seller's conspiracy will place price above marginal cost so relative to competitive behavior, an excess supply exists. The allocation of demand at such a relatively high price is critical to each seller's individual profits. In the double auction, operating under New York rules, and especially the multiple unit double auction in which an ask can be accompanied by a quantity available at the asking price, access to the buyers, and thus individual sellers volumes, are competitively determined. Only the lowest ask is exposed to the market. Anyone wishing to have an ask exposed to the market must tender an ask lower than the standing ask. If the standing ask is the agreed–upon price, then access to the market might be possible only by breaking the agreement and asking a price below that established in the cartel agreement. A conspiracy must find some mechanism for giving sellers access to buyers and for coordinating the allocation of volume among sellers in some agreeable fashion. Under the New York rules of the double auction, such coordination requires much more than a simple agreement on price.

Neither the continuous temptation nor the access to buyers (volume coordination) problems exist in the posted–price organization or in the sealed–bid process. In both posted price and sealed bid processes, there is no continuous temptation to defect. If a conspirator ever commits to an agreed–upon action, the commitment is final. After the initial commitment there is no opportunity to defect. The market access (coordination) problem is similarly nonexistent. All sellers have equal access to buyers. All sellers will be tendering the same price so unless some bias exists in the process, or in the way that buyers allocate their purchases across sellers, the volume is probablistically equally allocated among sellers.

In a sense the existence of an access to buyer's (coordination) problem reflects a lack of sophistication on the part of conspirators. Conspirators do not recognize the incompleteness of their agreement and do not attribute the incentive system and associated problems of maintaining their agreement to the incompleteness of that agreement. They recognize that they want prices high but they fail to recognize that higher prices must necessarily be accompanied by lower volume. They focus their collective attention and agree on one dimension of the phenomena, the high prices, but they fail to explore and agree upon the resolution of the other dimension, a reduction of volume. For example, a conspiracy that limits each seller to a prespecified volume and leaves prices unspecified might be more effective. Nevertheless, without volume restrictions market access becomes a critical issue which the double auction provides no help in resolving while both the posted price and the sealed bid organizations do.

The discussion above brings into focus the main question posed by this paper. Is the access–to–buyers problem (represented by the New York rule) either directly or indirectly responsible for the failure of conspiracies in the double auction institution? That is, if the access–to–buyers problem is removed within the multiple unit double auction framework, do the conspiracies still fail? If when the access problem is removed the conspiracies are not successful then a key institutional feature that disrupts the cartel must lie in the pricing decisions themselves, the continuous temptation, the interaction with buyers, etc.

3 The Individualized Seller Market Double Auction

The experimental design used in this study involved a change in the double auction to allow equal access to buyers for all sellers. This was achieved by opening a separate "market" for each seller.[2] Each seller could accept bids or tender any ask desired at any time in his/her own market but could not tender asks or accept bids in the market of other sellers. Buyers could tender bids in the market of any or all sellers or could accept asks in any or all markets. The only overriding rules were (i) the New York improvement rules applied to each market independently, and (ii) after 15 seconds market exposure a bid or ask could be canceled. Thus, the values of bids and asks could differ across markets and buyers had the freedom to cancel an offer made to one seller if he/she wanted to make an offer to a different seller without being exposed to the possibility of buying in both markets. The 15 second rule allowed adequate time for a seller or buyer to execute a transaction.

This new market institution which we will call the Individualized Seller Market Double Auction (ISMDA) can be used to test for the source of the organizational influences observed under conditions of conspiracy. Pilot experiments under conditions of no conspiracy demonstrated that markets organized under the ISMDA system converge to the competitive equilibrium. No tests were performed in a direct comparison with the traditional multiple unit double auction under conditions of no conspiracy since the convergence itself is the only dimension of interest. The pilot tests are not reported.

The ISMDA organization removes all problems of access to buyers that might exist for sellers. Relative volume can be determined in much the same way as it is under posted prices. If sellers ask the same price, then buyers will simply allocate themselves across sellers and if no bias exists, the expected volumes of all sellers should be the same. Thus, the ISMDA is the double auction institution. It is characterized by the continuous temptation property of the double auction but it does not have the access to buyers problem (the coordination problem). The ISMDA has all of the other features of the double auction.

[2]Similar market organizations have been used in experiments. See for example Miller and Plott (1985), or Lynch, Miller, Plott and Porter (1991).

4 Experimental Design, Parameters and Procedures

The relevant experiment is easily identified. Conduct ISMDA under conditions of conspiracy. If convergence to the competitive equilibrium is observed, or if the markets have properties similar to conspiracies operating under the double auction, then a conclusion is at hand. The nonfacilitating feature of the double auction would not be located exclusively in the way the double auction determines the access to buyers (coordination problem) feature. The unraveling of the conspiracy would be observed occurring under a "double–auction" institution when only the continuous temptation property and not the access to buyers problem was present. On the other hand, if effective conspiracies are observed under ISMDA, then a conclusion is at hand as well. Under such circumstances, the nonfacilitating attribute would be compartmentalized as stemming from the access to buyers (coordination) problem. Removal of the market access feature would have been accompanied by a transformation of an organization from one that does not facilitate successful conspiracy (MUDA) into one that does (ISMDA). Thus, the study of ISMDA alone is sufficient to compartmentalize part of the nonfacilitating feature of MUDA.

Four experiments were conducted at the California Institute of Technology. Subjects in the four experiments were from Caltech (experiments 2 and 4) and Oxidental College (experiments 1 and 3). Most of the subjects had no previous experience in experimental markets.

All experiments involved eight people. Four were designated as buyers and four were designated as sellers. Preferences were induced by application of induced preference theory. The redemption values and costs of individual buyers and sellers are in Table 1. When aggregated to the market level of analysis, the individual parameters are as appear in Figure 1. Parameters were identical for all periods for all individuals.

Instructions were read to all subjects. These are reproduced in the Appendix. Buyers were located in one room and sellers in a different room. Instructions were read separately to each group. The delicate part concerning the possibility of conspiracy was not read to buyers.

All participants were trained to use the computerized Multiple Unit Double Auction program (Johnson, Lee, and Plott, 1988) by participating in a stand–alone computerized instruction-package which demonstrates the location of keys and their function. Accounting and other instructions were administered verbally.

Each seller was assigned to a separate market. Sellers were unable to tender asks or to accept bids in the markets to which they were not assigned. Buyers were free to tender bids or accept asks in any of the four markets. Screen displays were such that the standing bid and ask were displayed in each market along with the identification

of the agent who tendered the action. Similarly, a history screen revealed transactions in each market and the people involved. Thus, the markets were characterized by full information about bids and contracts. Of course the redemption values and costs were private information.

Periods lasted for five minutes. Two minutes were allowed between periods for profit calculations, and for discussion among the potential conspirators.

5 Models

Two models are of interest. These will be used as benchmarks against which the influence of the institutions can be assessed.

The first is the competitive model. As is clear from Figure 1, the competitive equilibrium is in the price range of [$.70, $.80] and the volume is 22 units. Price movements in the range of the competitive equilibrium would be evidence that the conspiracy is not successful. Of course market efficiency should be 100 percent at the competitive equilibrium.

The second model is that of a profit maximizing cartel (with no side payments). Joint profits of sellers are maximized at a price of $1.00 and a volume of 16 units. Table 2 contains the profits for each of the two types of sellers based on the assumption that market volume is split evenly between the two types. All sellers prefer the price of $1.00 and an equal split of volume to the competitive equilibrium price and volume. Compare profits for individuals 0 and 1 of $2.43 per period on average when the price is $1.00 to the competitive equilibrium profits of $1.87 each. Similarly, sellers 2 and 3 would prefer an average profit of $2.44 per period at a price of $1.00 to the competitive equilibrium of $1.74. These figures assume that all surplus goes to the sellers.

A successful conspiracy that is unable to implement price discrimination would choose a price of $1.00. The market efficiency would be 90.82 percent. Of course, if price discrimination becomes possible, the conspiracy would do much better by simply "walking down" the demand curve.

6 Results

The graphs of the time series of bids, asks, and contracts are contained in Figures 2 through 5. Dollars are on the vertical axis and clock time (seconds) is measured on the horizontal. Vertical lines indicate the open and close of periods. Horizontal lines indicate the price predictions of the two models (1.00 for the cartel model and [.70,.80] for the competitive model). Contract prices in a given market are connected by a line. Thus, the figures contain four time series lines of contract prices, one for each of the four different sellers, each of which is operating in a different market. Dots above the contract lines tend to be the asks, pooled across all four markets, and the dots below the contract lines tend to be the bids, pooled across all four markets.

Conclusion 1. Conspiracies formed in all markets.

Support. The experimenter was present and could hear all conversations. In all experiments, conspiracies formed and attempted to maintain a price. In all experiments, except experiment 3, the conspiracy formed within the first few minutes of contact before the first period opened. In experiment 3 the conspiracy formed in period 5. In experiment 4 the conspiracy agreed to enforce a competitive equilibrium price of only .70 after the second period. In retrospect the report could have been more precise if the experimenter had maintained a log of the number of seconds that elapsed before the words "fix price" or phrases with equivalent meanings were mentioned along with other suggestions of agreement, e.g., "o.k."

Conclusion 2. In all experiments contract prices converged to the competitive equilibrium price range or were converging toward the range during the last few periods.

Support. Average prices for all periods of all four experiments are displayed in Table 3. In experiments 1, 2 and 4 prices are in the competitive price range of [$.70, $.80] by the last two periods. In experiment 3 three prices are closer to the competitive range than the cartel prediction of $1.00 in all periods but one. Experiment 4 is interesting because prices never exceeded the competitive range even though an active conspiracy was operating.

Conclusion 3. In all experiments volume was closer to the competitive equilibrium than that of the cartel model.

Support. Volume figures are in Table 3. In the last two periods of all experiments, the volumes are nearer the competitive equilibrium volume of 22 rather than the cartel volume of 16 units. The last five periods of the four experiments averaged values of 22, 20.6, 21.4, and 14, respectively. The volume in experiment 4 is a clear exception. Close examination reveals that some buyers were refusing to buy during periods 6, 7, 8, and 9.

This might have been an attempt to collude by the buyers. The low volume was a result of these actions by the buyers and not the success of a conspiracy of sellers. Thus the data from experiment 3 also supports the conclusion.

Conclusion 4. Conspiracies were not uniformly successful in getting seller profits above the competitive equilibrium. In no case were profits maintained near the cartel levels.

Support. Of the 36 periods reported, 18 involve seller profits that are greater than the competitive equilibrium profit levels. In only 9 of these were seller profits closer to the cartel model than the competitive equilibrium. Generally profits were closer to the competitive equilibrium than cartel levels.

Conjecture: Conspiracies reduced market efficiency by contributing to efficiency variability.

Support. No controls exist that would permit convincing measurements to be made of differences in market efficiencies that might accompany conspiracies. The support only comes from a judgement by the authors about the properties of efficiency time series characteristic of other markets. Typically efficiencies increase in a near monotone fashion until near 100 percent.

Conclusion 5. The continuous temptation to defect feature of the double auction exerts an influence capable of producing the "nonfacilitating" property independent of any influence of the New York rules (buyer access, coordination problem).

Support. Together conclusions 1 through 4 lead to conclusion 5. Conspiracies evolved but failed to be effective even though the buyer access problem had essentially the same features as the posted price process. The market behavior of the individualized seller market double auction is similar to the market behavior under the standard double auction with (New York) improvement rules.

7 Summary of Conclusions

When operating within posted price markets or sealed bid markets, inexperienced people readily participate in and implement successful conspiracies. The same cannot be said of inexperienced people operating within the framework of a multiple unit double auction. The research presented in this report provides a step in isolating the particular feature(s) of the organizations that foster this difference in behavior.

Two broad aspects are identified as potential key differences in the structures of the institutions. These are features of the double auction that are not present in the other

two institutions: (i) a continuous temptation to defect from a conspiratorial agreement, and (ii) competition for access to buyers, fostered by the New York rules which allow only the lowest ask to be exposed to the market. The question posed is whether the second of these features can account for the nonfacilitating nature of the double auction.

The answer suggested by the research is that some feature or features of the continuous temptation to defect property involves an important conspiracy–breaking ingredient. In the presence of the continuous temptation to defect the New York rule, limiting seller access to buyers, has no overriding influence on the unraveling of a conspiracy. In the presence of the continuous temptation to defect the conspiracies unravel whether the New York rule is in effect (MUDA) or not (ISMDA).

Of course, left unexplored is the possibility that the New York rule or similar (uncoordinating) devices might have an independent unraveling influence. At this stage of research it is not obvious what form such similar devices might take. Posted prices remove the continuous temptation property and would be a natural institution to which to attach a new device. The device might come in the form of specialized (first–come, first–served) access rules with priority to the best offer. Ideas along these lines have not been pursued so remain available for later studies with more appropriate technology and theory.

In retrospect the results reported here can be linked to other results to identify a possible continuity of observations. Smith (1981) demonstrated that monopoly has a difficult time charging monopoly prices when operating within the double auction and does much better under posted prices. Since a monopolist has no access to buyer problems the New York rule has no implications for the seller. In addition, the monopoly is involved in no conspiracy so there is no temptation to "defect" except perhaps from his/her previous decisions. It seems reasonable to suspect then that the sequential nature of actions and information together with the possible (counter–speculative) activities of buyers must be explored in greater detail before the central elements of the conspiracy–breaking properties of the institution can be isolated.

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Table 1

Induced Values in Dollars

Seller Costs			Buyer Redemption Values	
I.D. No./ Unit	0,1	2,3	4,5	6,7
1	.32	.28	1.18	1.22
2	.37	.37	1.13	1.13
3	.41	.41	1.09	1.09
4	.47	.50	1.03	1.00
5	.56	.70	.94	.80
6	.70	.81	.80	.69
7	.80	.92	.70	.58
8	.92	1.00	.58	.50
9	1.04	1.06	.46	.44
10	1.16		.34	

Table 2

Theoretical Profit Levels for Different Seller Types at Different Market Prices

	Seller Types 0, 1		Seller Types 2, 3	
Price	Combined Profit	Combined Volume	Combined Profit	Combined Volume
1.22	.94	1	.90	1
1.18	1.67	2	1.62	2
1.13	3.14	4	3.22	4
1.09	4.34	6	4.42	6
1.03	4.54	7	4.59	7
1.00	4.86	8	4.88	8
.94	4.76	9	4.64	9
.80	3.94	12	3.48	10

Table 3

Average Prices (Cents) and Values

	Experiment							
	1		2		3		4	
Period	Price	Volume	Price	Volume	Price	Volume	Price	Volume
1	56	24	0	0	79	18	69	22
2	90	15	118	1	84	25	63	18
3	81	22	114	13	104	26	68	21
4	69	21	104	17	86	21	69	21
5	73	23	103	19	87	22	69	21
6	79	19	96	23	85	21	69	11
7	73	23	89	19	86	21	71	11
8	73	23	83	20	85	21	69	7
9	72	22	79	23	87	22	70	14
10	73	19	76	21			70	20
11	72	23	74	20			70	17

Table 4

Profit Per Period
(In Cents)

Theoretical	Competive Model		Cartel Model	
	Buyers	Sellers	Buyers	Sellers
	632	632	174	974
	Experiment 1		Experiment 2	
Experimental	Buyers	Sellers	Buyers	Sellers
Period				
1	1075	60	0	0
2	291	716	4	86
3	418	756	-15	877
4	674	349	73	1030
5	660	499	66	1123
6	675	445	137	1053
7	633	576	354	849
8	651	458	443	733
9	690	553	545	685
10	607	409	583	641
11	706	526	542	599

Table 4 Continued

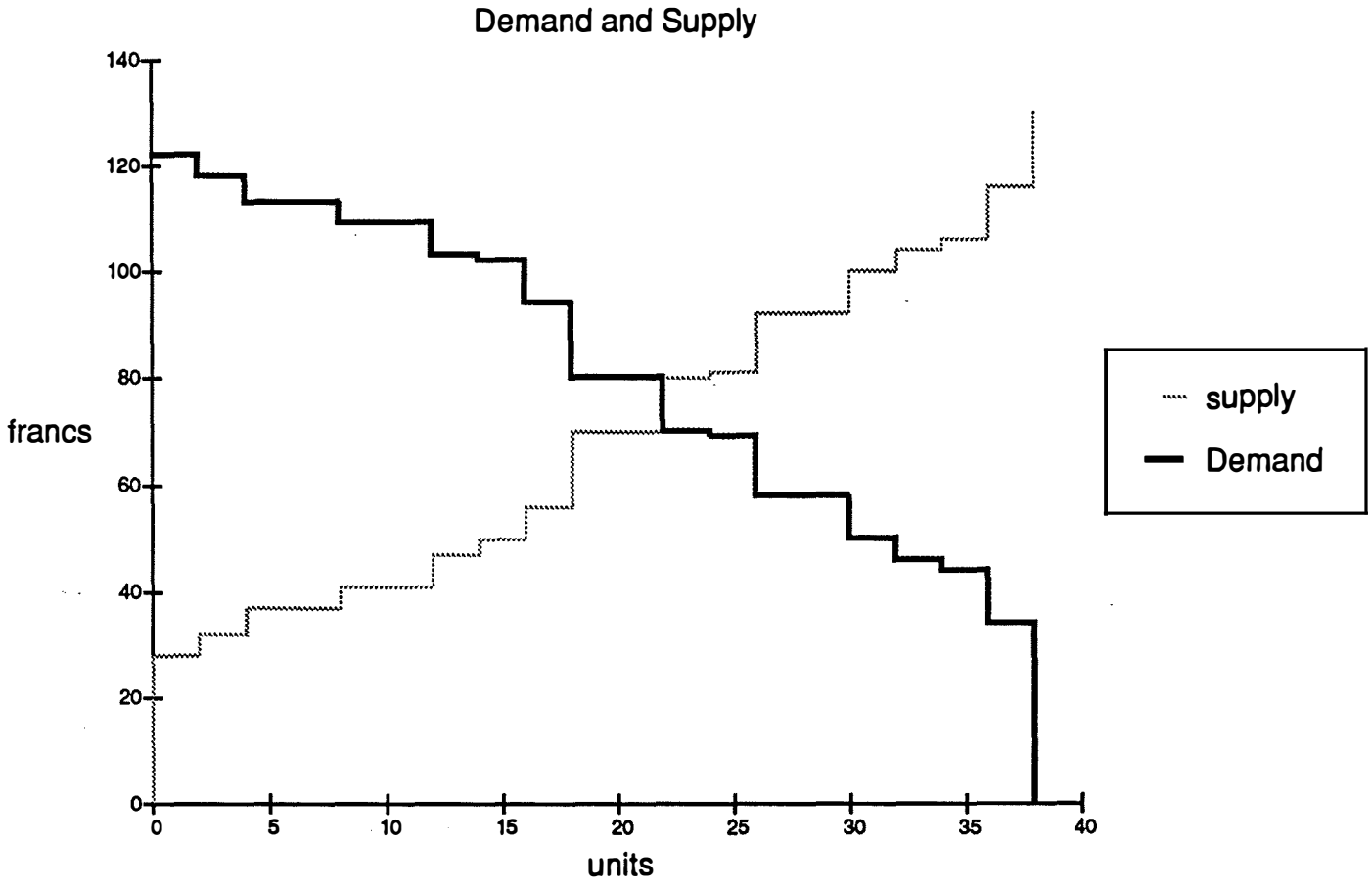
	Experiment 3		Experiment 4	
Period	Buyers	Sellers	Buyers	Sellers
1	404	472	755	348
2	245	702	663	403
3	-187	1283	573	480
4	392	822	714	499
5	379	875	-57	489
6	411	773		
7	397	829		
8	412	677		
9	363	681		
10				
11				

Table 5

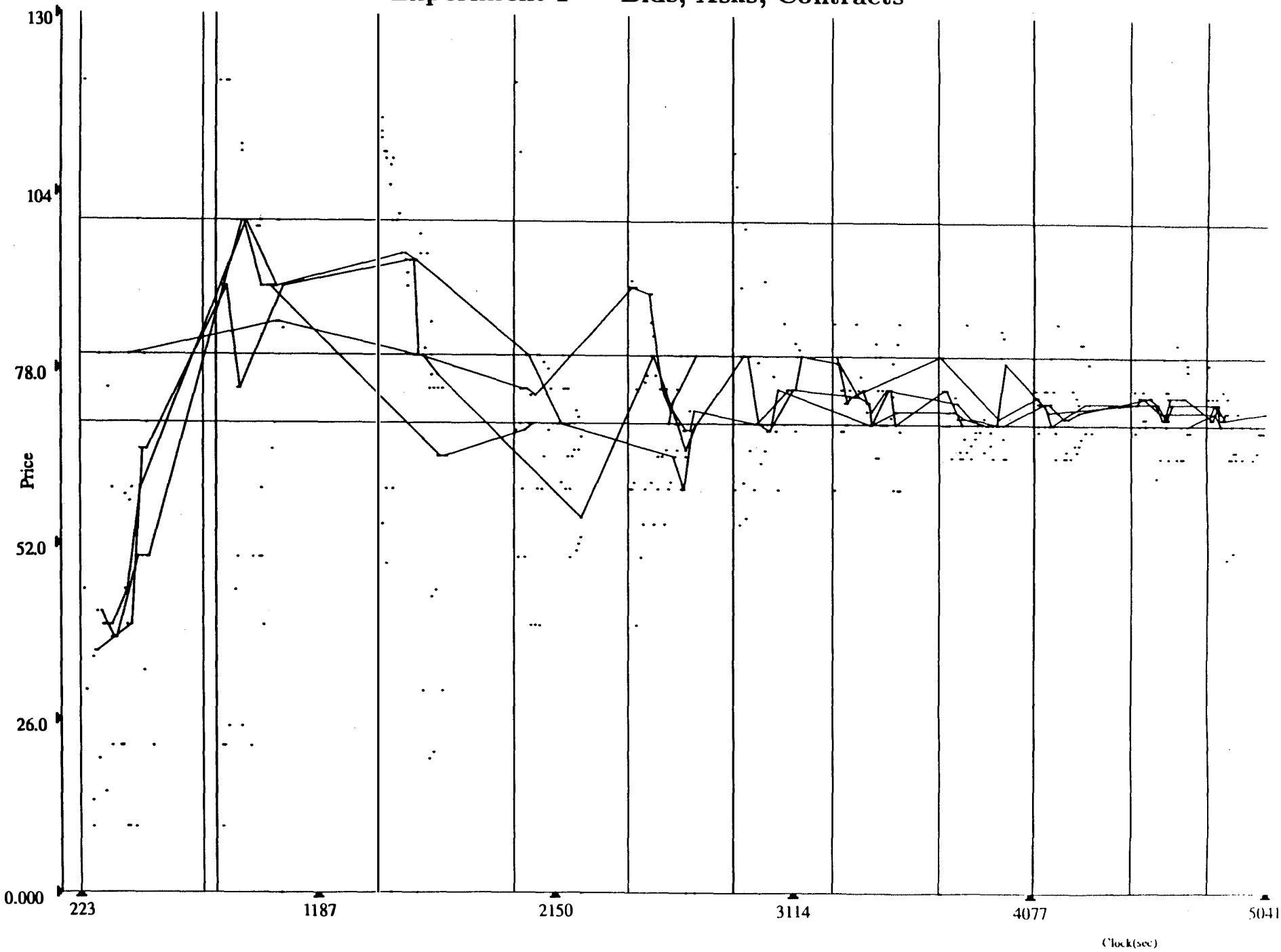
Efficiency in Percent

Period	Experiment 1	2	3	4
1	89.32	0	73.89	87.34
2	78.88	6.8	74.92	84.33
3	92.88	68.2	86.71	83.31
4	80.93	87.26	96.84	95.97
5	92.33	94.07	99.20	34.17
6	83.70	94.15	93.67	59.97
7	95.65	95.17	97.23	54.35
8	87.74	93.04	86.16	78.16
9	98.34	97.31	86.16	97.31
10	80.70	96.84		97.31
11	97.47	90.27		87.10
12				

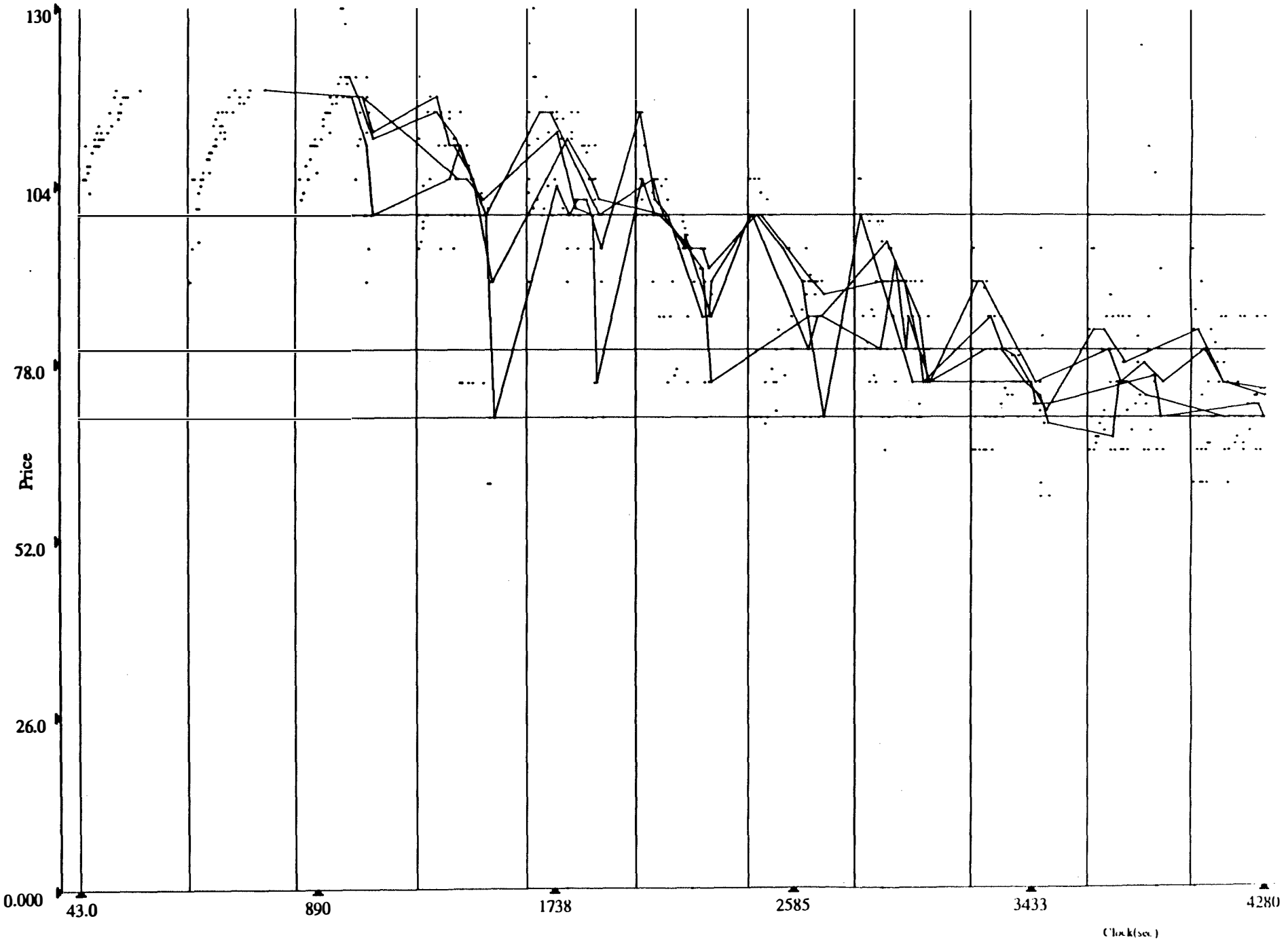
FIGURE 1


Demand and Supply
140
120
100
80
60
40
20
0
francs
0
5
10
15
20
25
30
35
40
units
supply
Demand

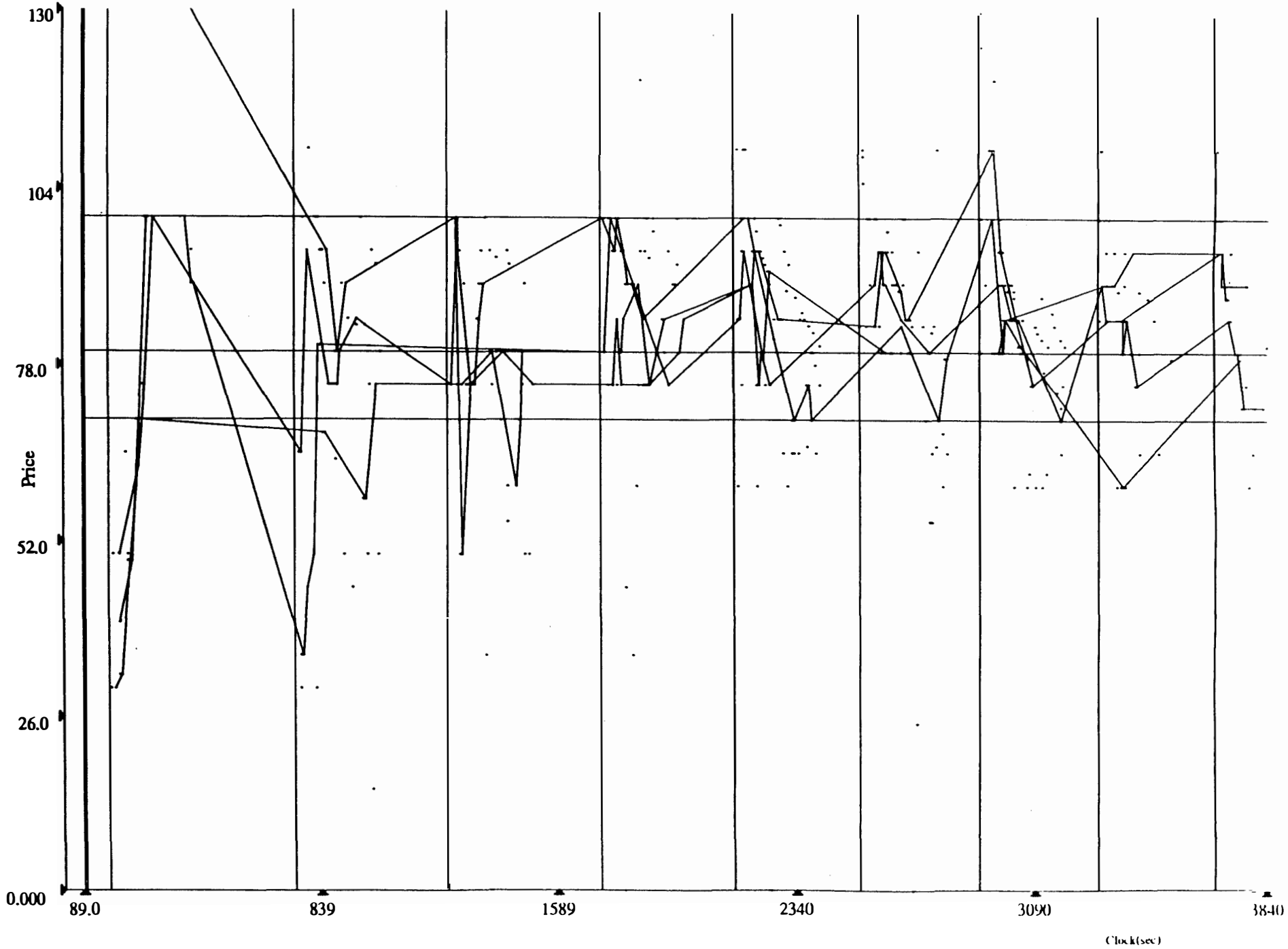
Experiment 1 — Bids, Asks, Contracts



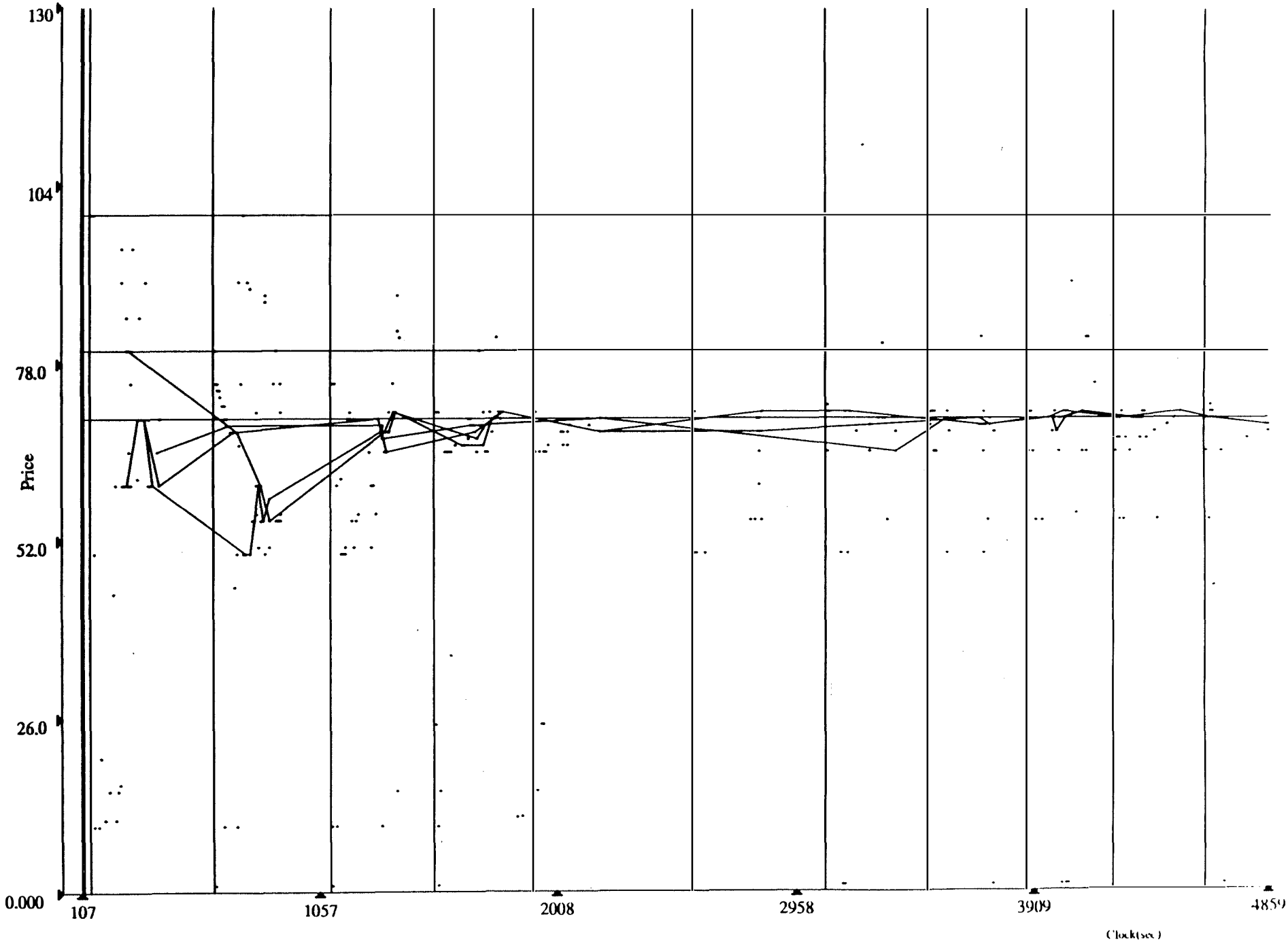
Experiment 2 — Bids, Asks, Contracts



Experiment 3 — Bids, Asks, Contracts



Experiment 4 — Bids, Asks, Contracts



APPENDIX

Instructions

This is an experiment in the economics of market decisionmaking. Various research foundations have provided funds for this research. The instructions are simple and, if you follow them carefully and make good decisions, you might earn a considerable amount of money which will be paid to you in cash.

In this experiment we are going to simulate a market in which some of you will be buyers and some of you will be sellers in a sequence of market days or trading periods. Attached to the instructions you will find a sheet labeled 'Buyer' or 'Seller', which describes the value to you of any decisions you might make. **You are not to reveal this information to anyone.** It is your own private information.

Buyers

During each market period you are free to purchase from any seller or sellers as many units as you might want. For the first unit that you buy **during a trading period** you will receive the amount listed in row (1) marked '**first unit redemption value**'; if you buy a second unit, you will receive the additional amount listed in row (5) marked "**second unit redemption value**'; etc. The profits from each purchase (which are yours to keep) are computed by taking the difference between the redemption value and purchase price of the unit bought. That is,

[your earnings = (redemption value) - (purchase price)].

Suppose, for example, that you buy two units and that your redemption value for the first unit is 200 and for the second unit is 180. If you pay 150 for your first unit and 160 for the second unit, your earnings are:

earnings from first = 200 - 150 = 50

earnings from second = 180 - 160 = 20

total earnings = 50 + 20 = 70

The blanks on the table will help you record your profits. The purchase price of the first unit you buy during the first period should be recorded on row (2) **at the time of purchase.** You should then record the profits on this purchase as directed on row (3). At the end of the period record the total of profits on the last row on the page. Subsequent periods should be recorded similarly.

Sellers

During each market period you are free to sell to any buyer or buyers as many units as you might want. The first unit that you sell during a trading period you obtain at a cost of the amount listed on the attached sheet in the row (2) marked '**cost of first unit**'; if you sell a second unit, you incur the cost listed in row (6) marked '**cost of second unit**'; etc. The profits from each sale (which are yours to keep) are computed by taking the difference between the price at which you sold the

unit and the cost of the unit. That is,

[your earnings = (sale price of unit) - (cost of unit)]

Suppose, for example, your cost of the first unit is 140 and your cost of the second unit is 160. For illustrative purposes we will consider only a two-unit case. If you sell the first unit at 200 and the second unit at 190, your earnings are

earnings from first = 200 - 140 = 60,
earnings from second = 190 - 160 = 30,
total earnings = 60 + 30 = 90

The blanks on the table will help you record your profits. The sale price of the first unit you sell during the first period should be recorded on row (1) at the time of the sale. You should then record the profits on this sale as directed on row (3). At the end of the period, record the total of profits on the last row on the page. Subsequent periods should be recorded similarly.

Market Organization

Markets will be organized through the computer. Everyone has been instructed in the technical features of how they can be used. In this experiment, there will be the same number of markets as their are sellers. Each seller will be allowed to sell goods in only one of these

markets. He/She will be the only seller in that market. At the beginning of each market trading period, each seller will be assigned to one of the markets. During that period, that seller may not change markets and no other seller may sell in his/her market. In contrast, each buyer may purchase units in any of the markets or place bids in any market.

Communication Among Buyers

During this experiment, you are not to speak to any person other than the person in charge.

Communication Among Sellers

Except for the time between market trading periods, you are not to speak to any person other than the person in charge. Between market trading periods you are free to discuss whatever you wish as long as you stay within the confines of the rules: you cannot discuss side payments or make physical threats and you can't reveal the detailed quantitative information on your payoff charts. Other than those specific things you can discuss all aspects of the market fully.

Instructions

This is an experiment in the economics of market decisionmaking. Various research foundations have provided funds for this research. The instructions are simple and, if you follow them carefully and make good decisions, you might earn a considerable amount of money which will be paid to you in cash.

In this experiment we are going to simulate a market in which some of you will be buyers and some of you will be sellers in a sequence of market days or trading periods. Attached to the instructions you will find a sheet labeled 'Buyer' or 'Seller', which describes the value to you of any decisions you might make. **You are not to reveal this information to anyone.** It is your own private information.

Buyers

During each market period you are free to purchase from any seller or sellers as many units as you might want. For the first unit that you buy **during a trading period** you will receive the amount listed in row (1) marked '**first unit redemption value**'; if you buy a second unit, you will receive the additional amount listed in row (5) marked "**second unit redemption value**'; etc. The profits from each purchase (which are yours to keep) are computed by taking the difference between the redemption value and purchase price of the unit bought. That is,

[your earnings = (redemption value) - (purchase price)].

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earnings from first = 200 - 150 = 50

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total earnings = 50 + 20 = 70

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Sellers

During each market period you are free to sell to any buyer or buyers as many units as you might want. The first unit that you sell during a trading period you obtain at a cost of the amount listed on the attached sheet in the row (2) marked 'cost of first unit'; if you sell a second unit, you incur the cost listed in row (6) marked 'cost of second unit'; etc. The profits from each sale (which are yours to keep) are computed by taking the difference between the price at which you sold the

unit and the cost of the unit. That is,

[your earnings = (sale price of unit) - (cost of unit)]

Suppose, for example, your cost of the first unit is 140 and your cost of the second unit is 160. For illustrative purposes we will consider only a two-unit case. If you sell the first unit at 200 and the second unit at 190, your earnings are

earnings from first = 200 - 140 = 60,
earnings from second = 190 - 160 = 30,
total earnings = 60 + 30 = 90

The blanks on the table will help you record your profits. The sale price of the first unit you sell during the first period should be recorded on row (1) at the time of the sale. You should then record the profits on this sale as directed on row (3). At the end of the period, record the total of profits on the last row on the page. Subsequent periods should be recorded similarly.

Market Organization

Markets will be organized through the computer. Everyone has been instructed in the technical features of how they can be used. In this experiment, there will be the same number of markets as their are sellers. Each seller will be allowed to sell goods in only one of these

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